US009153893B2

(12) **United States Patent**
Yamada et al.

(10) **Patent No.: US 9,153,893 B2**
(45) **Date of Patent: Oct. 6, 2015**

(54) **TERMINAL BLOCK**

(71) Applicant: **Sumitomo Wiring Systems, Ltd.**, Yokkaichi, Mie (JP)

(72) Inventors: **Hiroki Yamada**, Yokkaichi (JP); **Daisuke Akuta**, Yokkaichi (JP)

(73) Assignee: **Sumitomo Wiring Systems, Ltd.** (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 59 days.

(21) Appl. No.: **14/071,991**

(22) Filed: **Nov. 5, 2013**

(65) **Prior Publication Data**

US 2014/0134891 A1 May 15, 2014

(30) **Foreign Application Priority Data**

Nov. 13, 2012 (JP) 2012-249567

(51) **Int. Cl.**

H01R 13/42	(2006.01)
H01R 9/24	(2006.01)
H01R 43/18	(2006.01)
H01R 4/34	(2006.01)
H01R 13/512	(2006.01)
H01R 107/00	(2006.01)

(52) **U.S. Cl.**

CPC ***H01R 13/42*** (2013.01); ***H01R 9/24*** (2013.01); ***H01R 43/18*** (2013.01); *H01R 4/34* (2013.01); *H01R 13/512* (2013.01); *H01R 2107/00* (2013.01)

(58) **Field of Classification Search**

USPC 439/722, 709, 86, 626, 660

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,937,550	A *	2/1976	Gillemot	439/603
7,955,141	B2 *	6/2011	Jang et al.	439/709
8,894,449	B2 *	11/2014	Matsumoto et al.	439/727
8,905,783	B2 *	12/2014	Umemoto et al.	439/587
2010/0297890	A1 *	11/2010	Yang et al.	439/660
2011/0117784	A1 *	5/2011	Matsuoka et al.	439/626
2011/0117792	A1 *	5/2011	Kaneshiro	439/709
2011/0130049	A1 *	6/2011	Kaneshiro	439/709
2012/0164867	A1 *	6/2012	Matsumoto et al.	439/345
2012/0186872	A1 *	7/2012	Akuta	174/70 B
2012/0190232	A1 *	7/2012	Akuta	439/487
2012/0190251	A1 *	7/2012	Akuta	439/722
2012/0223601	A1 *	9/2012	Akuta	310/58
2012/0225593	A1 *	9/2012	Akuta	439/722
2013/0040473	A1 *	2/2013	Tanaka et al.	439/86
2013/0095704	A1 *	4/2013	Awakura et al.	439/709

FOREIGN PATENT DOCUMENTS

GB	2490441	10/2012
JP	11-144783	5/1999

* cited by examiner

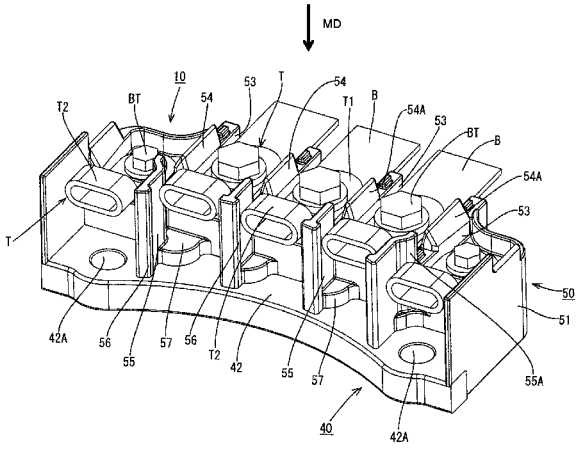
Primary Examiner — Alexander Gilman

(74) *Attorney, Agent, or Firm* — Gerald E. Hespos; Michael J. Porco; Matthew T. Hespos

(57) **ABSTRACT**

A terminal block (**10**) connects terminals (T) at ends of wires extending from a motor and busbars (B) extending from an inverter and includes nuts (**20**) on which the terminals (T) and the busbars (B) are placed and which fasten the terminals (T) and the busbars (B) together with bolts (BT). A bracket (**40**) is arranged below the nuts (**20**), and a resin portion (**50**) integrally fixes the nuts (**20**) and the bracket (**40**). The bracket (**40**) includes a mounting portion (**42**) exposed from the resin portion (**50**) and is fixed to a metal motor case. An embedded portion (**41**) is embedded in the resin portion (**50**). The resin portion (**50**) includes first locks (**57**) for locking screw grooves (**47**A) of screw holes (**47**) on the mounting portion (**42**) from below, and a second lock (**58**) for locking an engaging portion **49** on the embedded portion (**41**) from below.

9 Claims, 18 Drawing Sheets



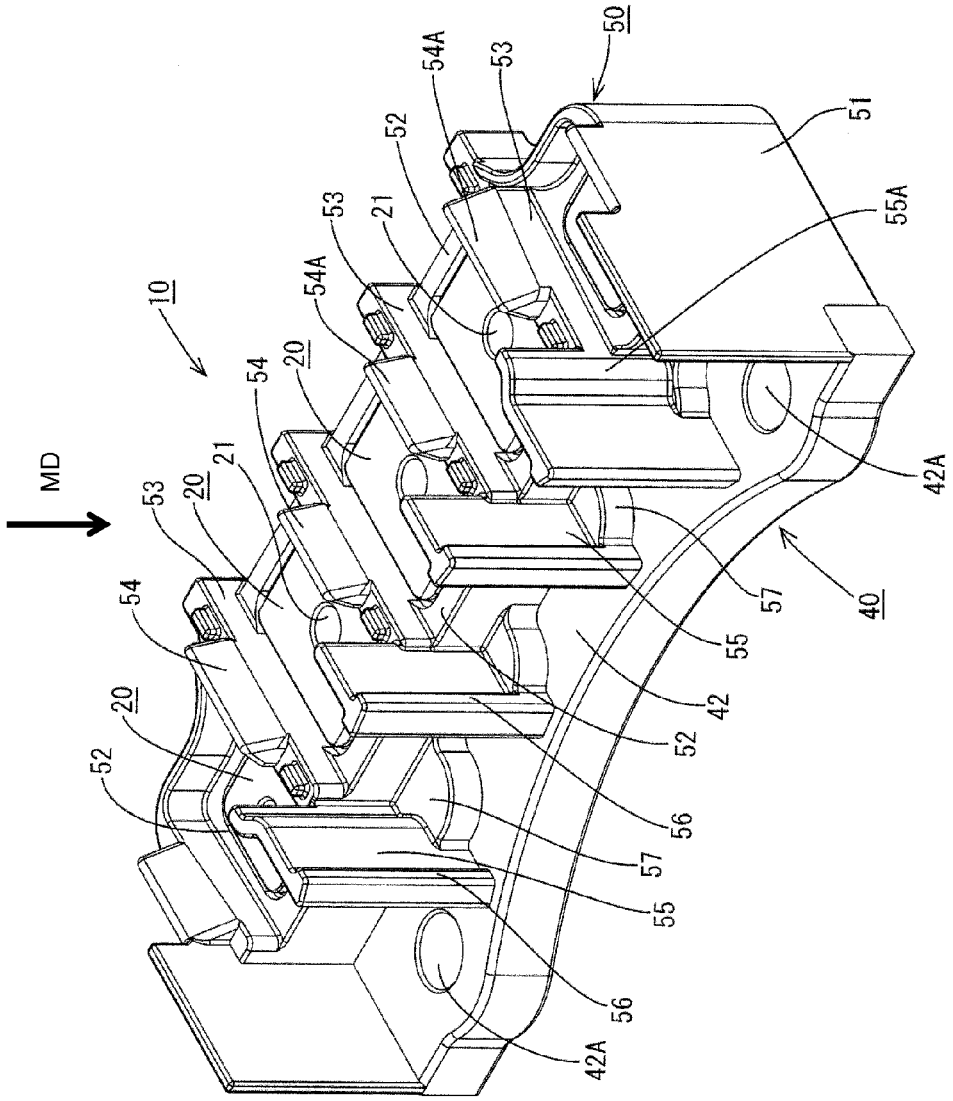


FIG. 1

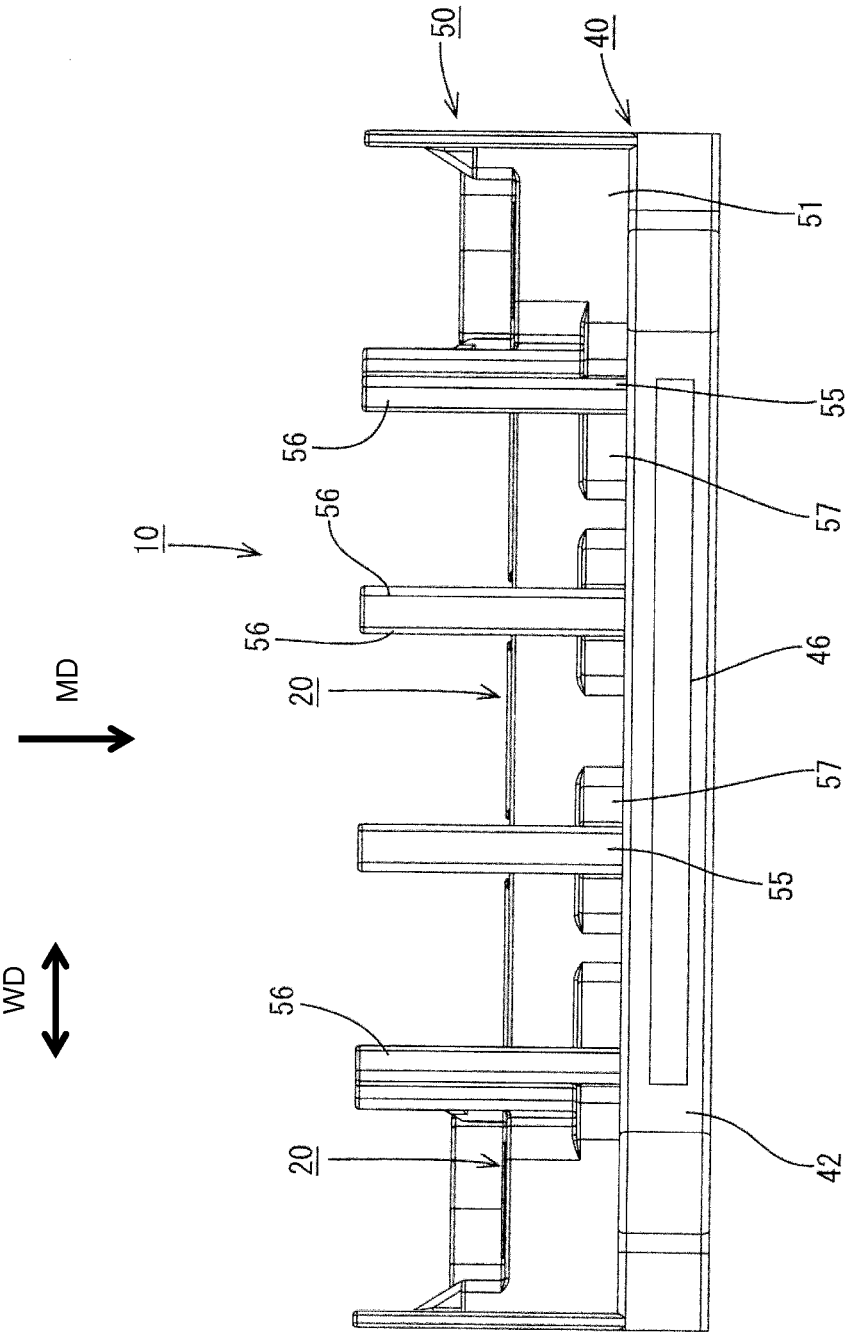


FIG. 2

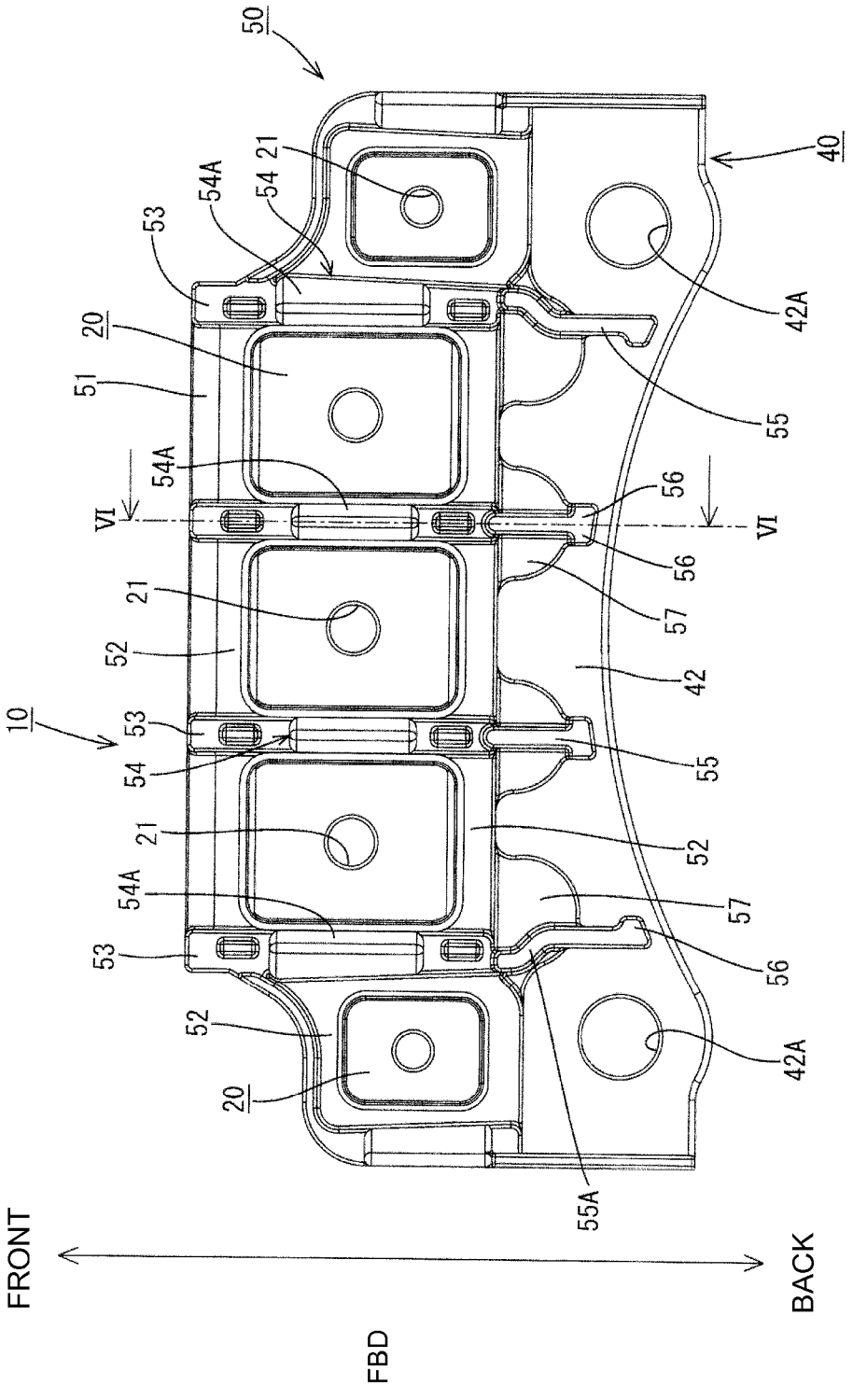

50
40
21
54A
54
53
42A
20
51
55
VI
VI
56
57
52
42
10
55
52
57
56
42A
20
55A
FRONT
BACK
FBD

FIG. 3

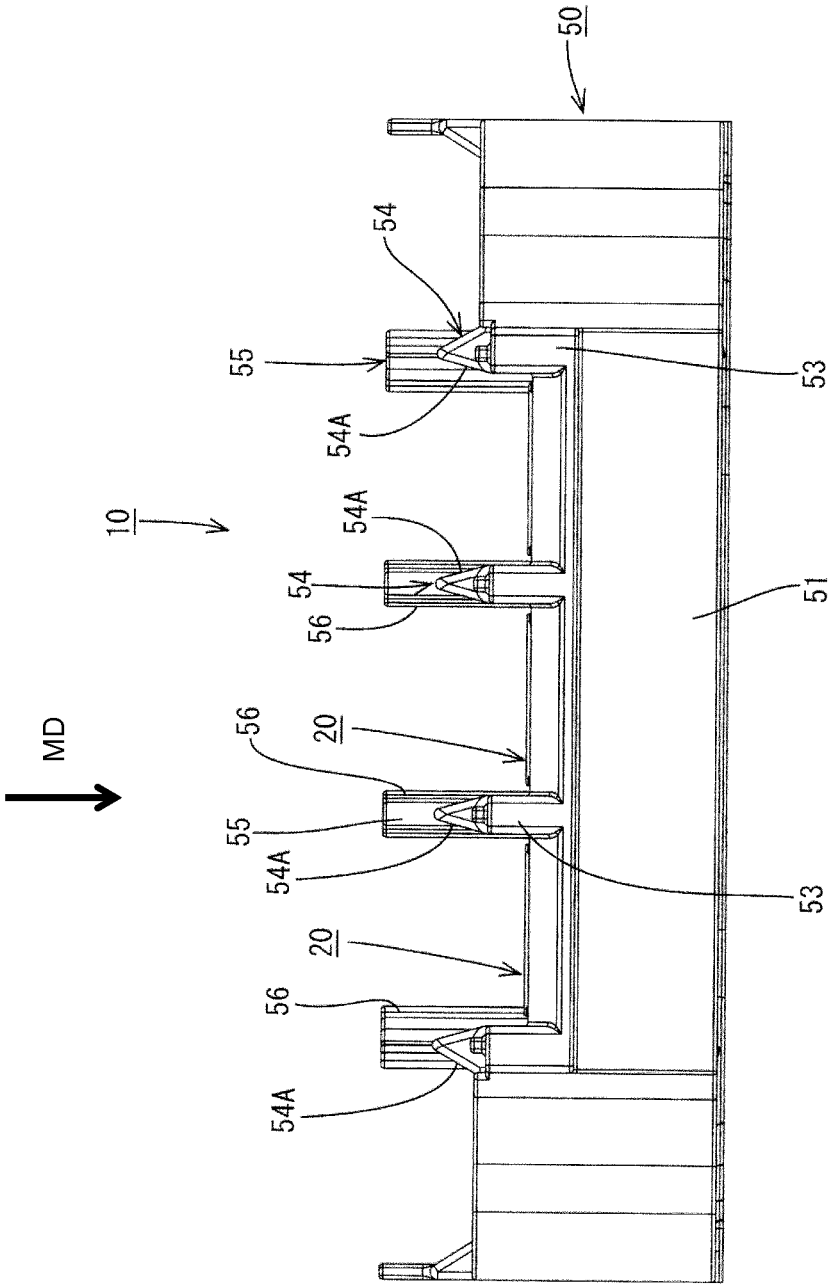


FIG. 4

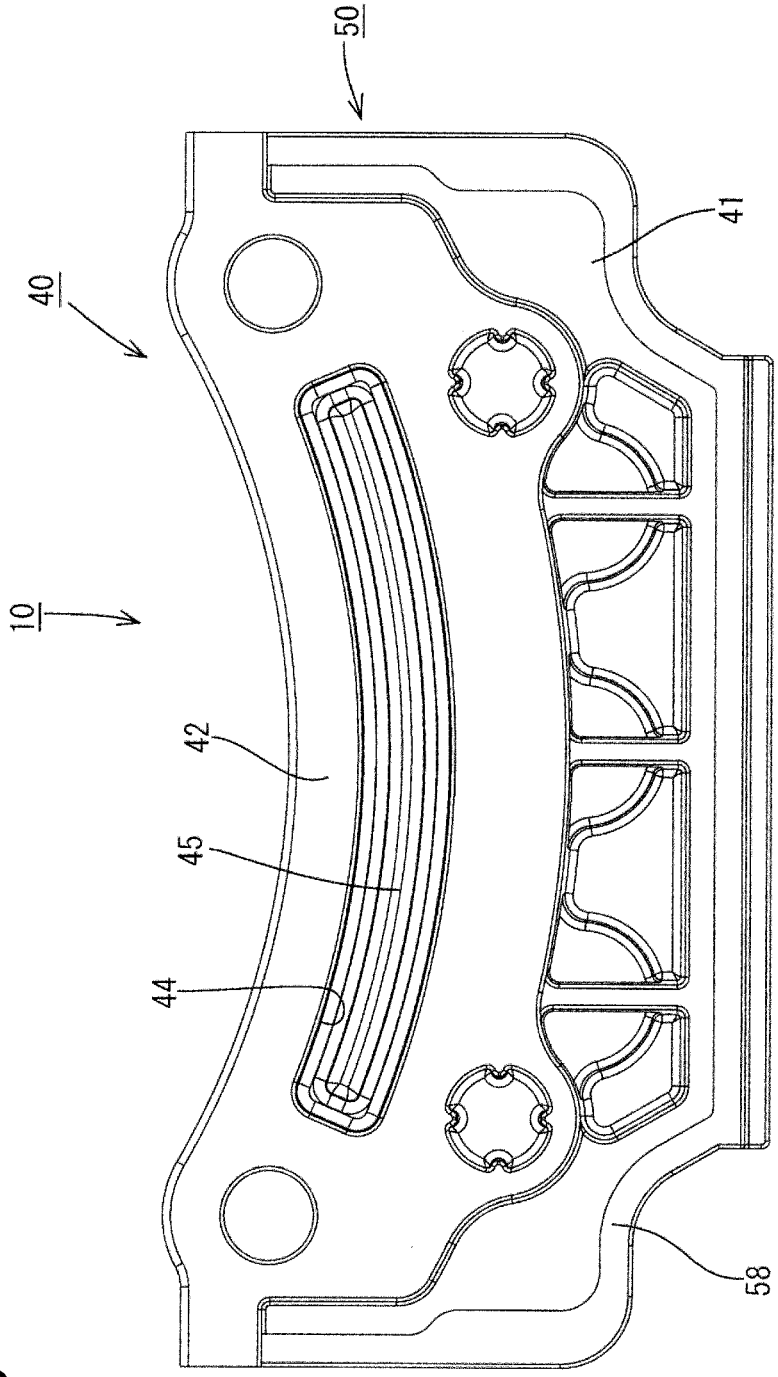


FIG. 5

FIG. 6

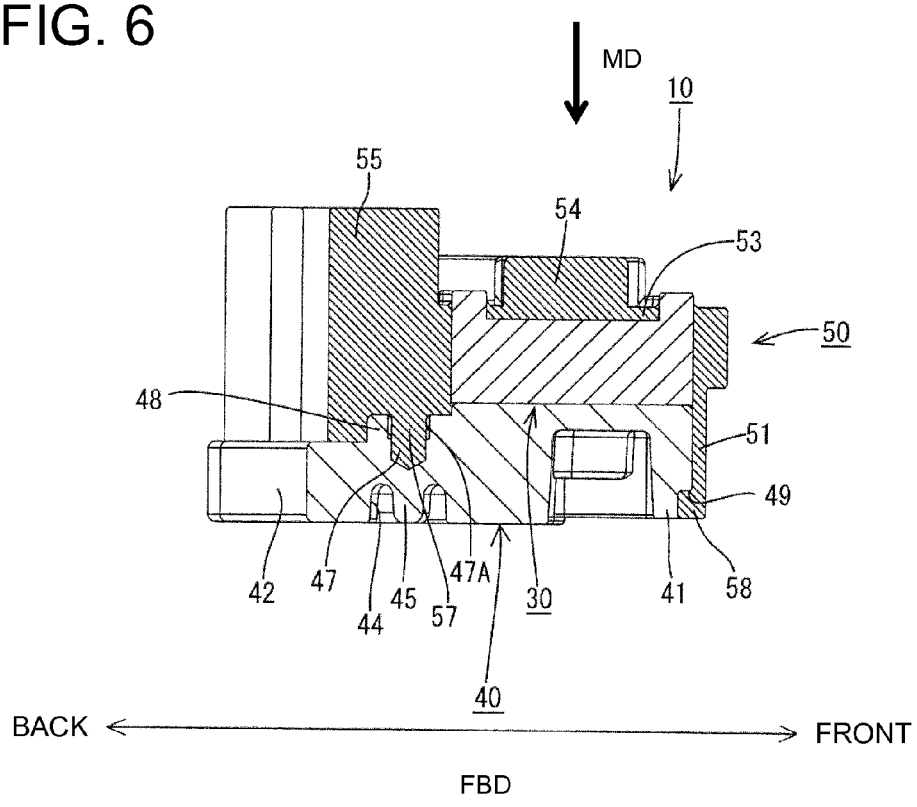
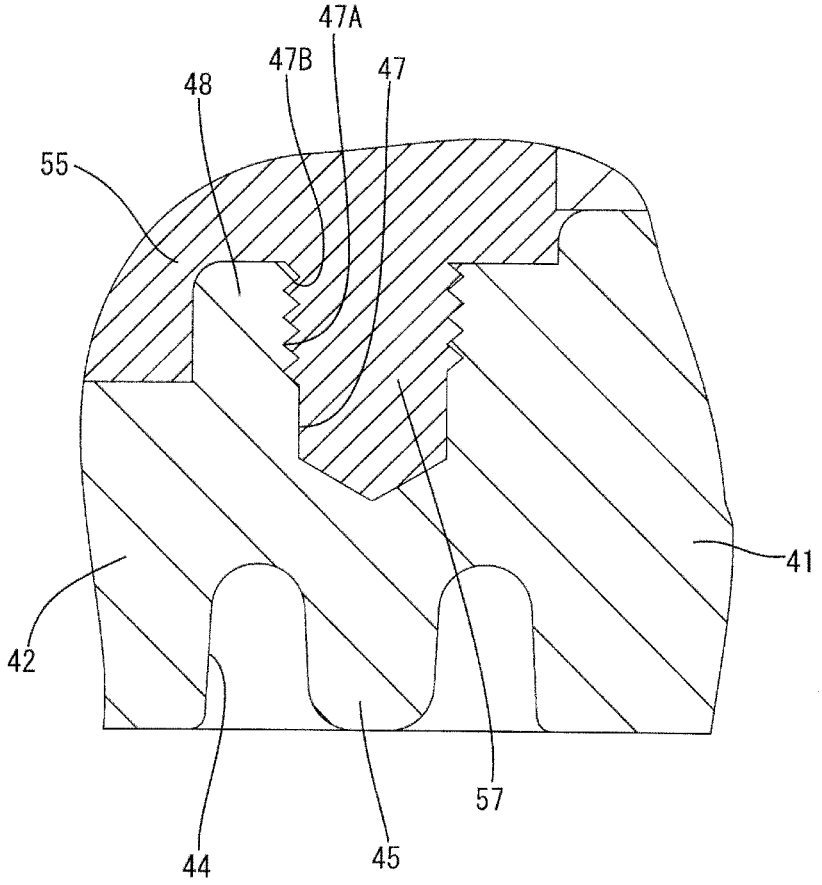

MD
10
55
54
53
50
48
51
49
42
47
44
45
57
47A
30
41
58
40
BACK
FRONT
FBD

FIG. 7



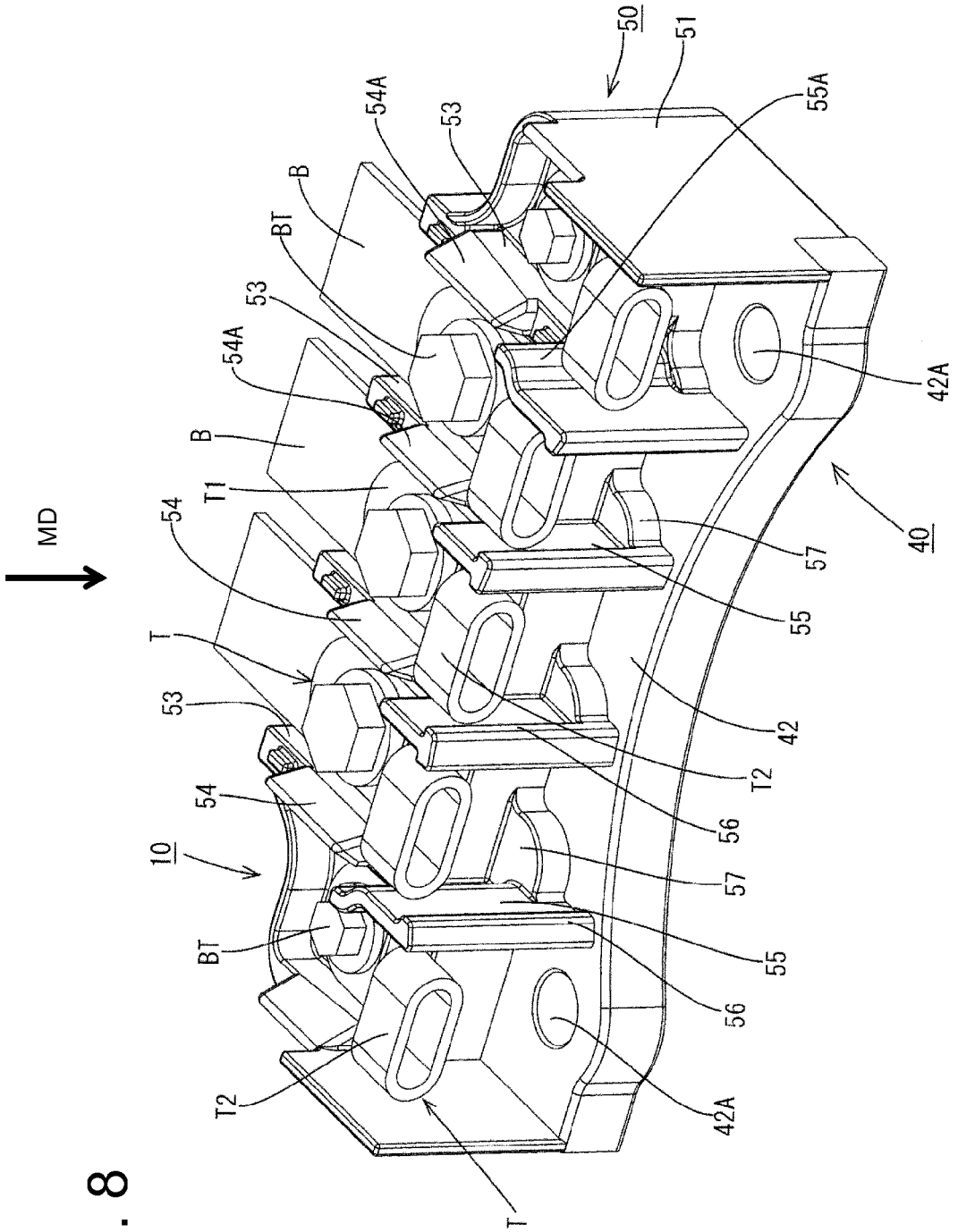

MD
50
51
55A
54A
53
B
BT
53
54A
B
T1
54
T
53
54
10
BT
T2
T
42A
56
55
57
42
T2
56
57
55
42A
40

FIG. 8

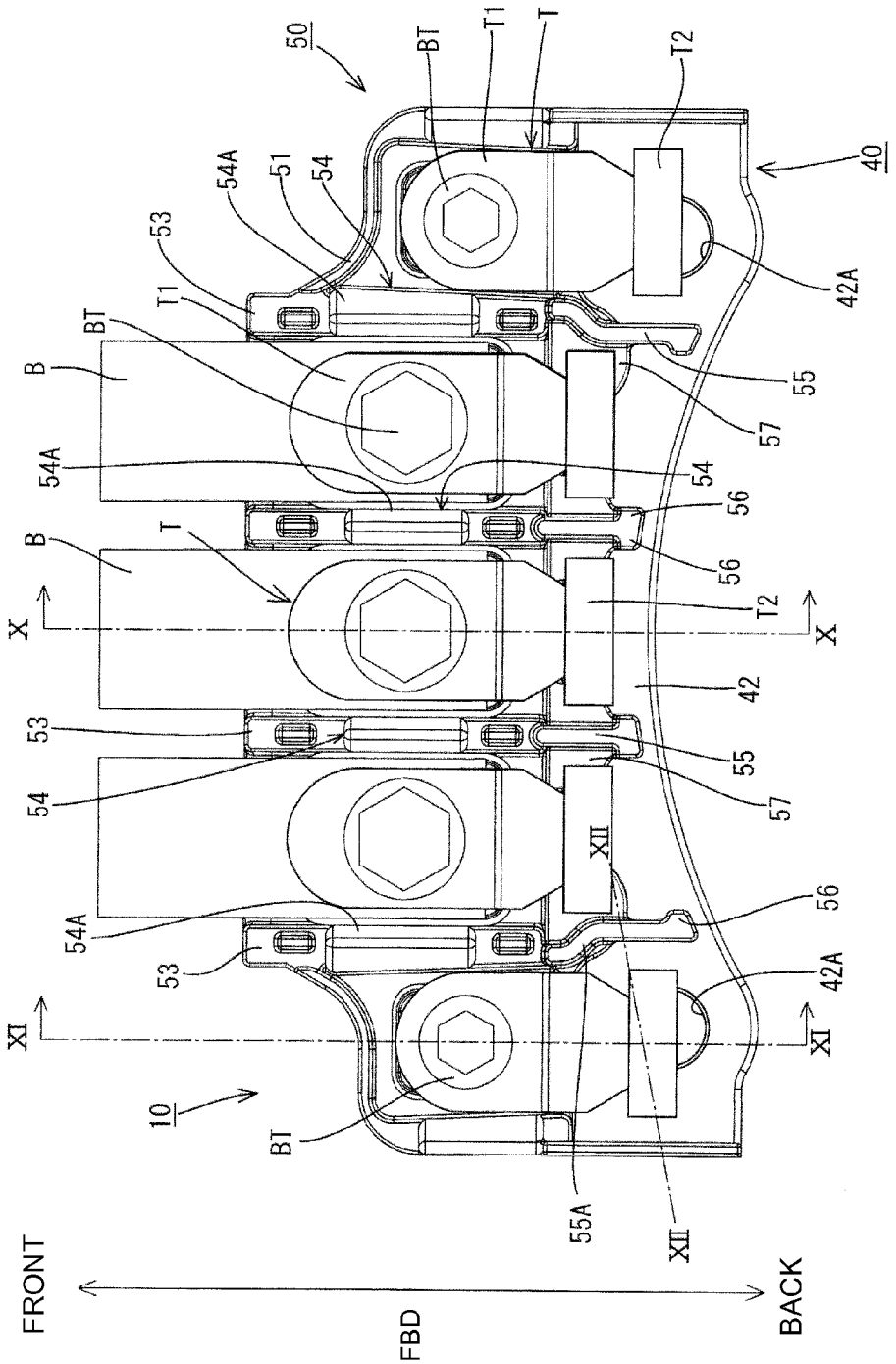

50
BT
T1
T
T2
40
54A
51
54
53
42A
B
55
57
56
X
42
XII
XI
10
55A
FRONT
FBD
BACK

FIG. 9

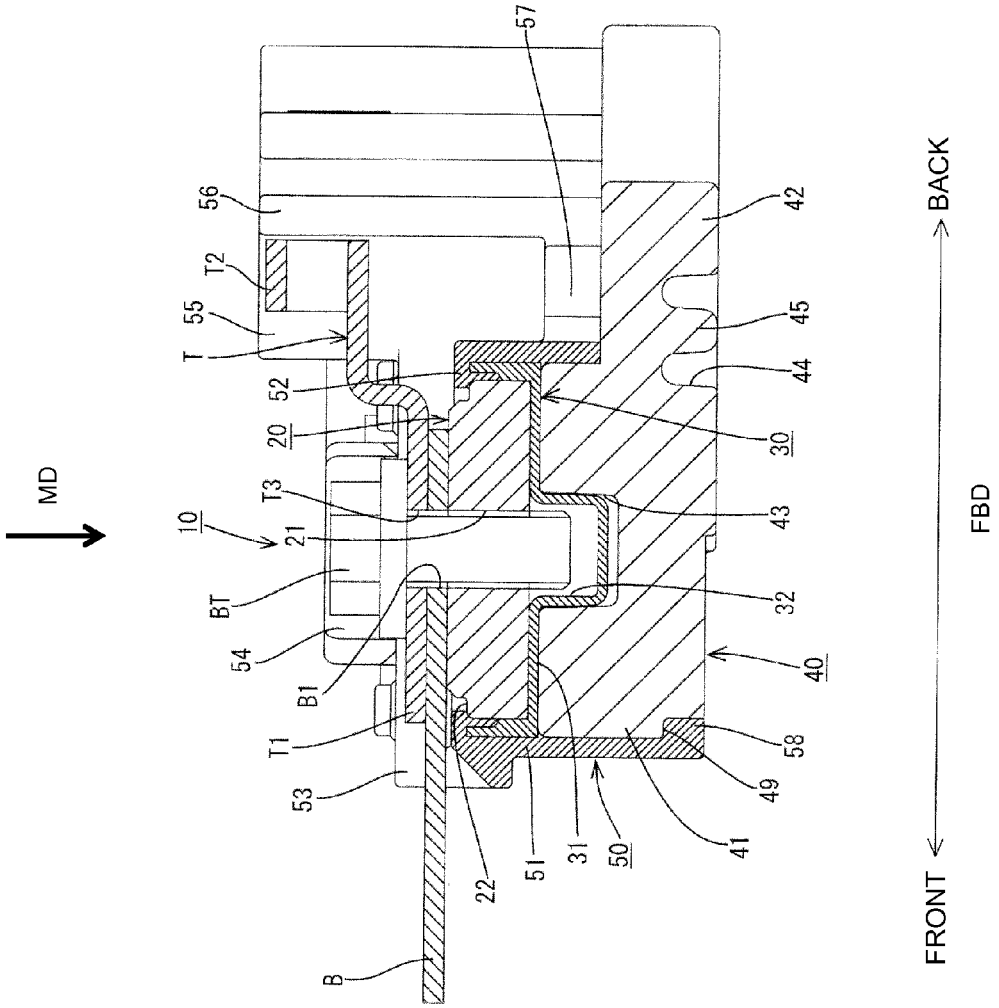

MD
57
56
T2
55
T
52
20
10
21
T3
BT
54
B1
T1
53
B
22
51
31
50
41
49
58
40
32
43
30
44
45
42
BACK
FBD
FRONT

FIG. 10

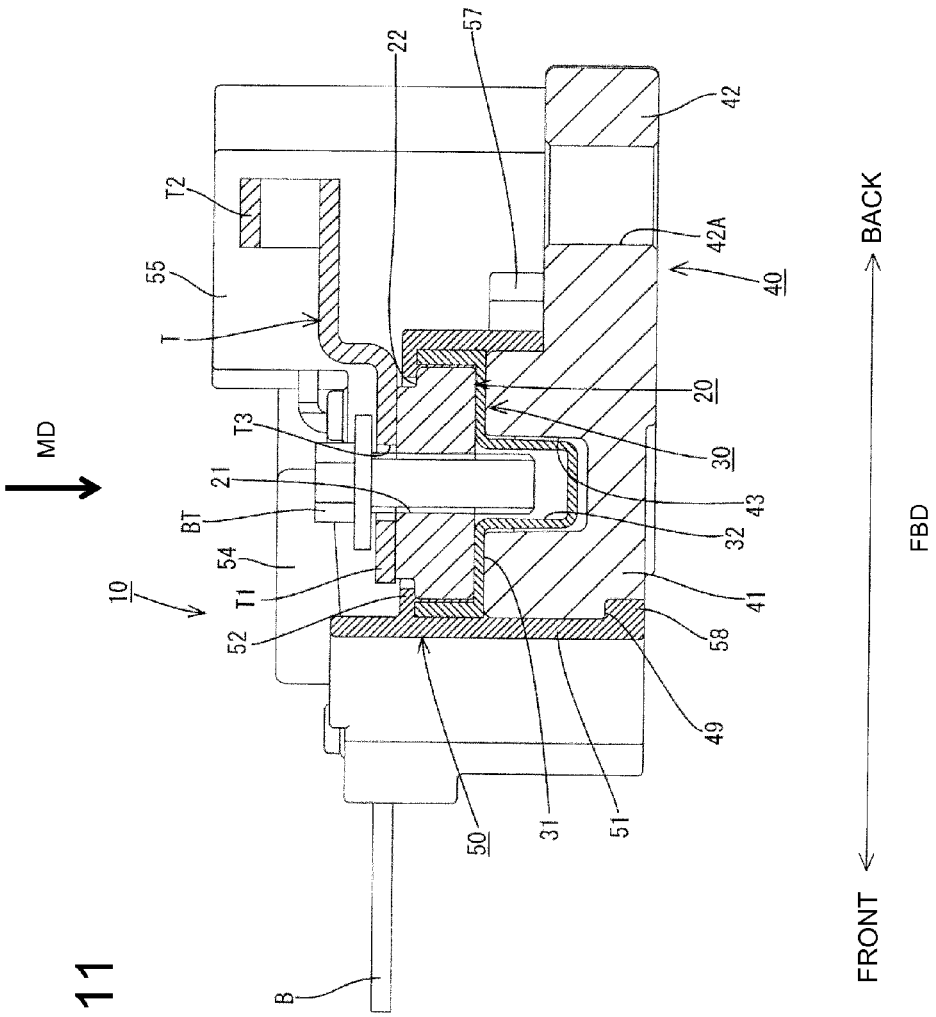
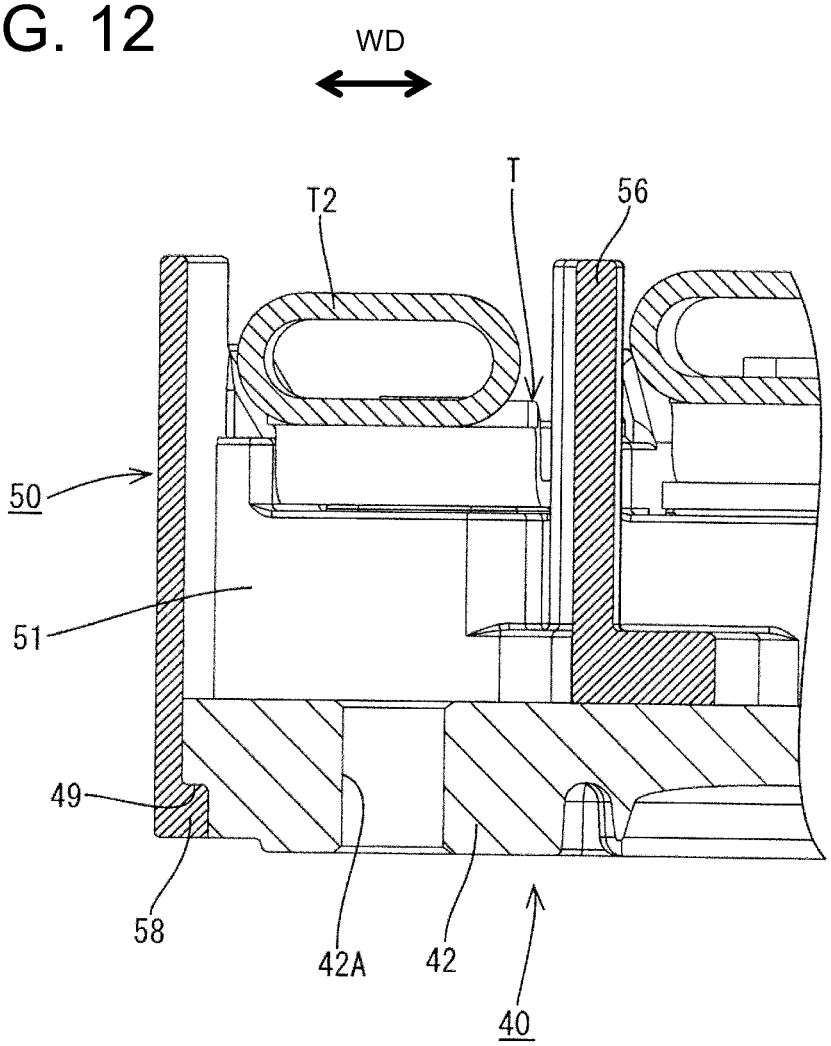

MD
22
57
42
T2
42A
55
40
I
20
T3
30
21
43
BT
32
54
41
10
T1
52
58
49
50
31
51
B
BACK
FBD
FRONT

FIG. 11

FIG. 12



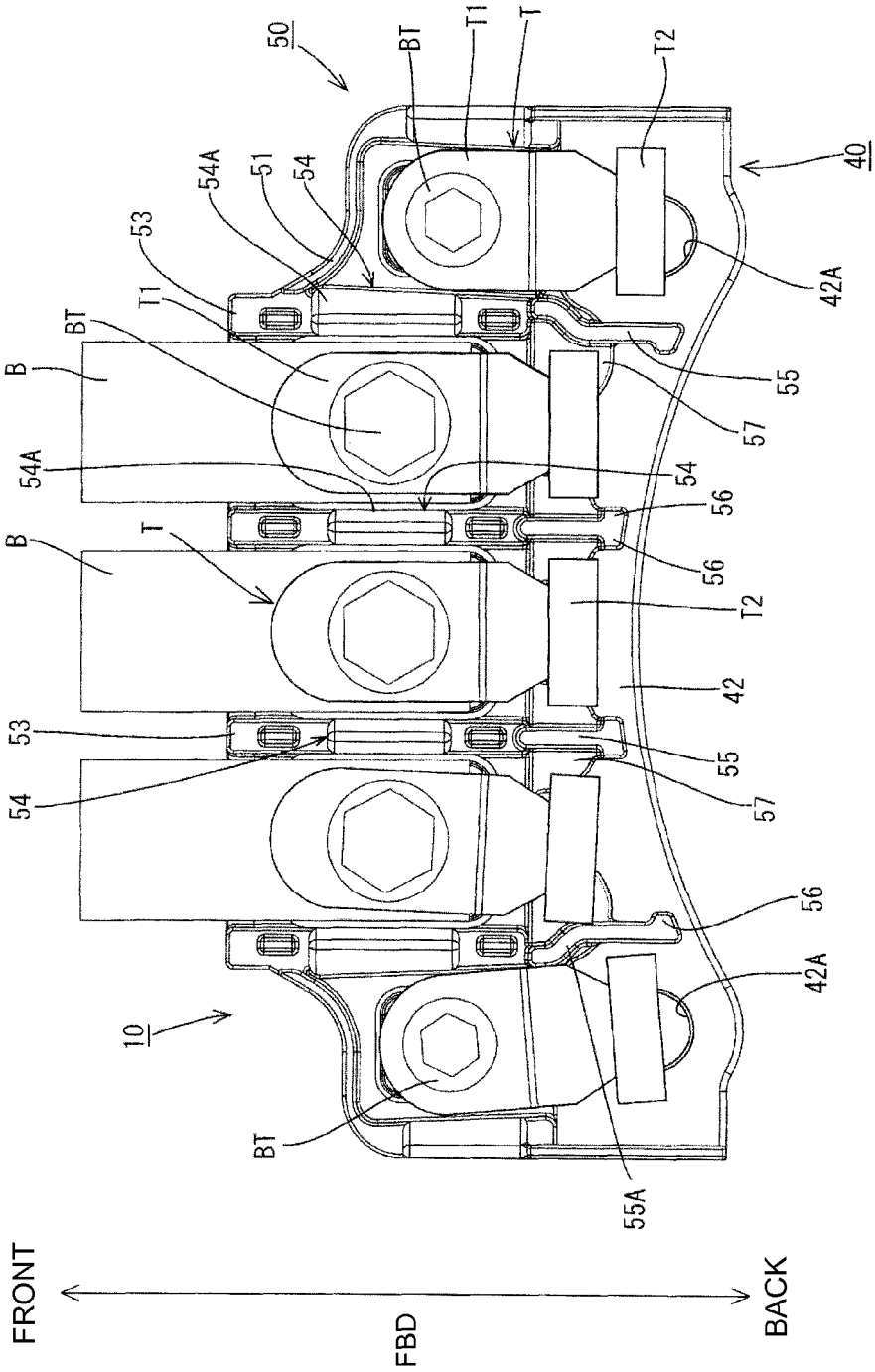

50
BT
T1
T
T2
40
54A
51
54
53
42A
T1
BT
B
55
57
54A
54
56
B
T
56
T2
42
53
55
54
57
56
42A
10
BT
55A
FRONT
FBD
BACK

FIG. 13

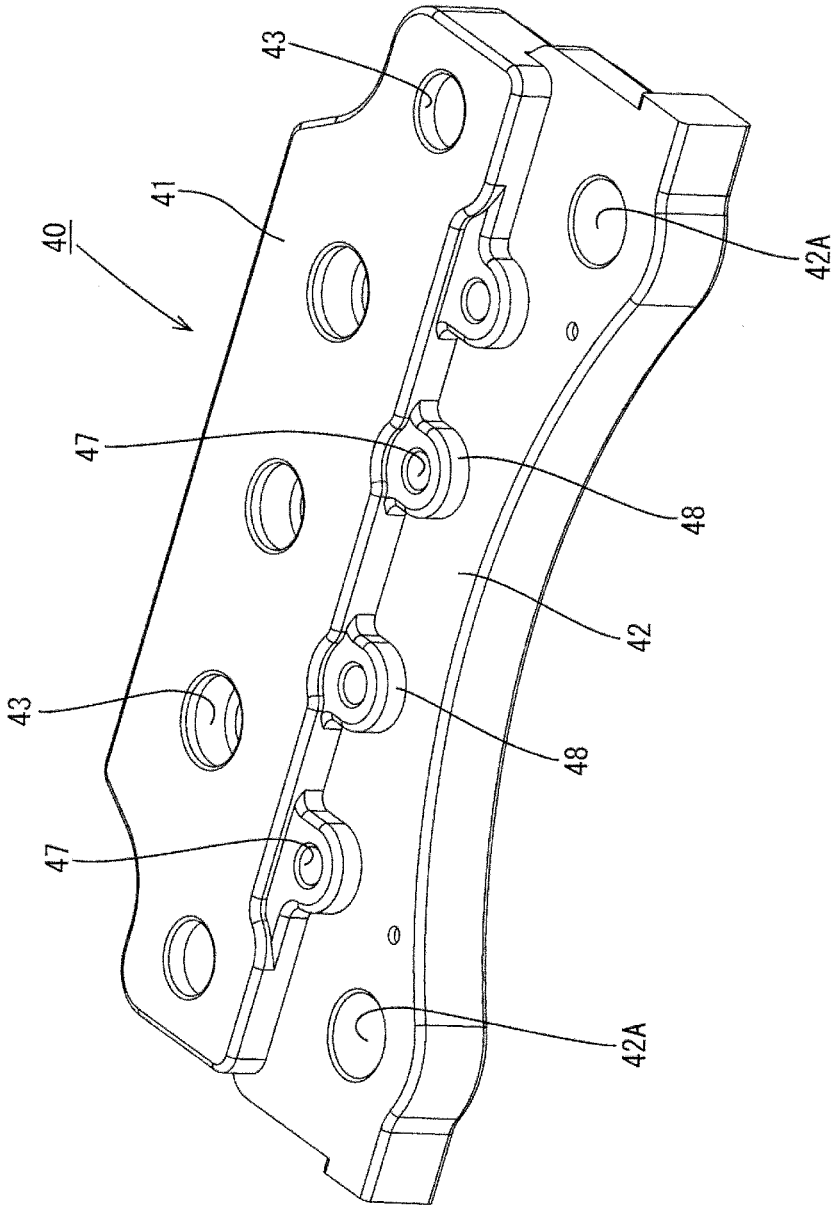


FIG. 14

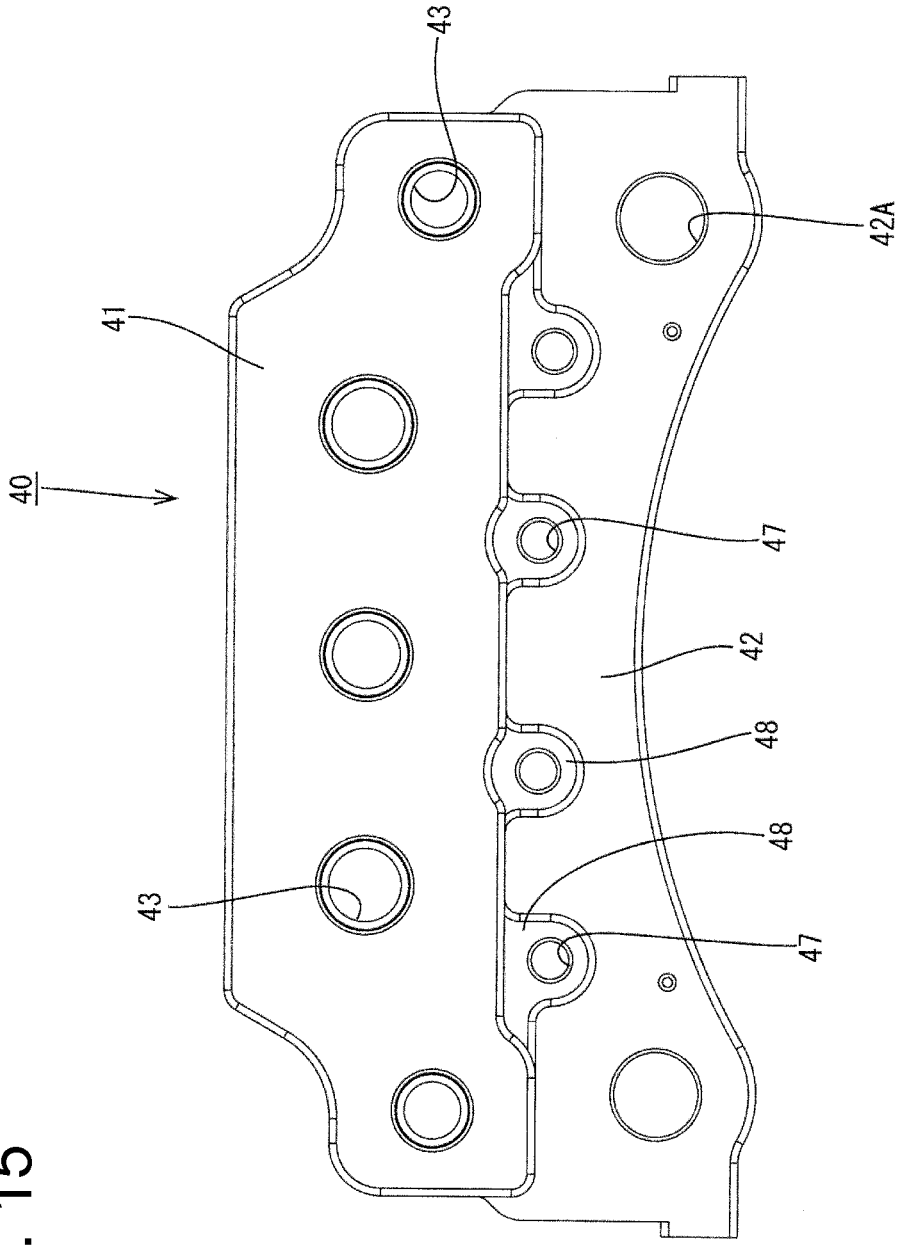
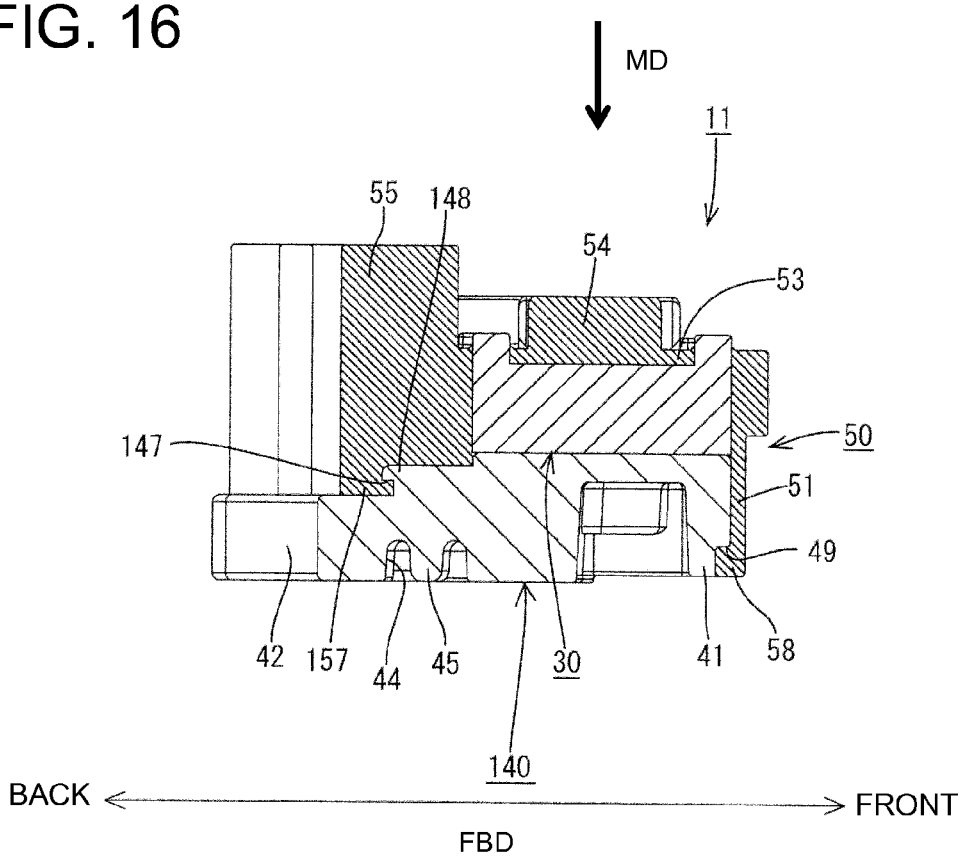


FIG. 15

FIG. 16


MD
11
55
148
54
53
147
50
51
49
42
157
44
45
30
41
58
140
BACK
FRONT
FBD

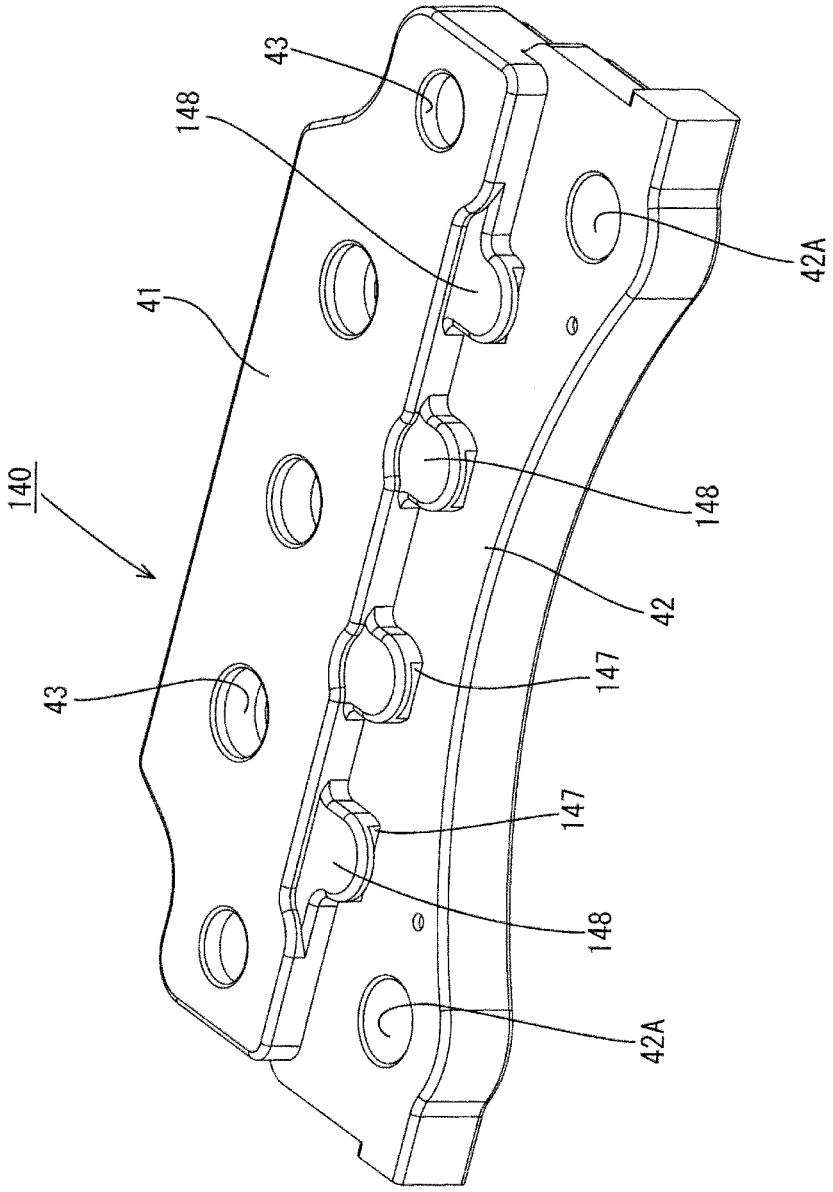


FIG. 17

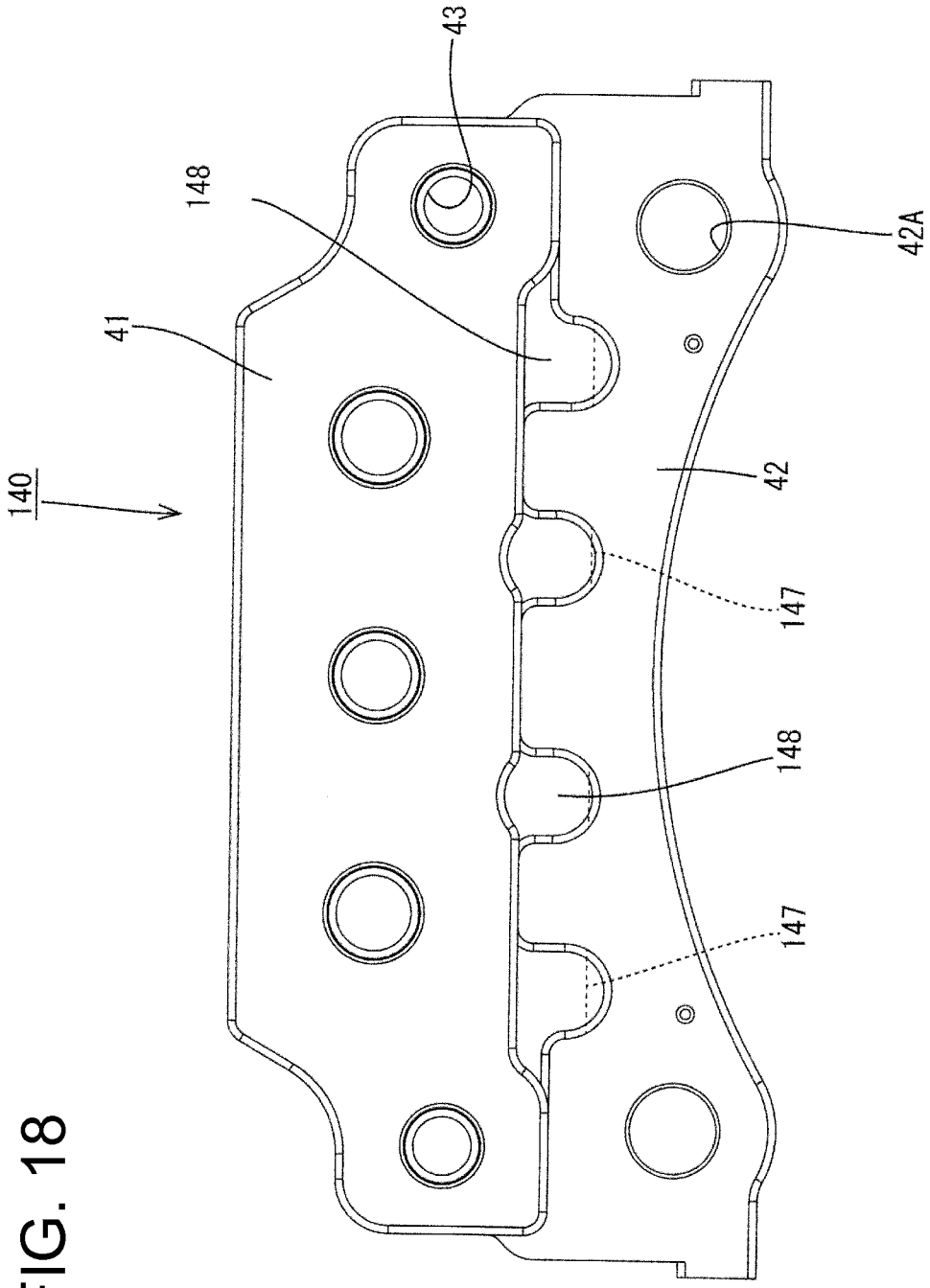


FIG. 18

TERMINAL BLOCK

BACKGROUND

1. Field of the Invention

The invention relates to a terminal block.

2. Description of the Related Art

Japanese Unexamined Patent Publication No. H11-144783 discloses a terminal block for connecting a pair of terminals. This terminal block is configured so that the respective terminals are placed one over the other on a main body formed with a metal nut insert molded inside and electrically connected to each other by being fastened together by a bolt and the nut.

According to such a terminal block, heat generated from conductive members such as terminals is transferred to the nut and accumulated in the terminal block. Thus, it has been attempted to arrange a metal bracket fixed to a case of a motor below the nut via an insulating sheet, integrally fix these three members by a resin portion, transfer heat transferred from the conductive members to the nut to the bracket via the insulating sheet and radiate this heat from the bracket to the case of the motor.

Further, the bracket needs to be directly in contact with the case to radiate the heat from the bracket to the case, and it is necessary to reduce a covered part of the bracket by the resin portion. However, if the covered part of the bracket is small, the resin portion is pulled toward the bolt together with the nut and the resin portion and the bracket are separated at the time of bolt tightening.

The invention was completed in view of the above situation and an object thereof is to prevent the separation of a bracket and a resin portion while improving a heat radiation property of the bracket.

SUMMARY OF THE INVENTION

The invention relates to a terminal block for connecting a conductive member extending from a device and a mating conductive member. The terminal block includes a fastening seat on which the conductive member and the mating conductive member are placed. A bolt fastens the fastening seat, the conductive member and the mating conductive member together with a bolt. A metal bracket is adjacent to the fastening seat and a resin portion covers a part of the fastening seat and the bracket to fix the fastening seat integrally with the bracket. The bracket has at least one mounting portion exposed from the resin portion and fixed to a metal case for housing the device and at least one embedded portion embedded in the resin portion. The resin portion includes a first locking portion for locking a first engaging portion on the mounting portion and a second locking portion for locking a second engaging portion on the embedded portion.

Heat of the bracket of the above-described terminal block can be radiated to the metal case from the mounting portion directly fixed to the metal case. There is concern that the resin portion will be pulled up with the fastening seat as the bolt is tightened into the fastening seat and that the bracket fixed to the case may be separated from the resin portion. However, the second locking portion of the resin portion locks the second engaging portion of the embedded portion from below. Therefore, the bracket and the resin portion cannot separate at the embedded portion side.

The first engaging portion of the mounting portion is locked from below by the first locking portion of the resin portion. Thus, the bracket cannot separate from the resin portion at the mounting portion side and heat radiation from the bracket to the case is improved.

The fastening seats are arranged substantially in a width direction intersecting an extending direction of the conductive member.

The resin portion preferably includes nut locking portions for locking outer peripheral edges of the fastening seats. At least one partition wall is provided between adjacent nut locking portions for partitioning between adjacent fastening seats.

The first locking portion preferably is on an end of the partition wall.

According to such a configuration, one first locking portion supports two adjacent nut locking portions to prevent separation of the bracket and the resin portion. Thus, the structure of the mounting portion is simplified by reducing the number of the first locking portions as compared with providing a first locking portion for each nut locking portion.

The lower surface of the mounting portion fixed to the case is recessed up to form at least one heat radiation recess for radiating heat of the bracket by taking in coolant for cooling the interior of the case.

The first engaging portion may be formed by cutting a built-up portion above the heat radiation recess.

An attempt could be made to form the first engaging portion above the heat radiation recess by cutting without providing the mounting portion with the built-up portion. This approach would cause a side of the mounting portion above the heat radiation recess to become thinner, and, thus, the first engaging portion could not be formed. However, the invention forms the first engaging portion by cutting the build-up portion on top of the mounting portion. Thus, the heat radiation recess and the first engaging portion can be provided vertically one above the other on the mounting portion. This approach prevents enlarging the mounting portion as compared with the case where the mounting portion and the heat radiation recess are formed without being arranged one above the other.

The first engaging portion may comprise a screw hole including a screw groove on an inner peripheral surface. Thus, the first locking portion of the resin portion can firmly lock the screw groove.

A plurality of the first engaging portions may be arranged in a width direction intersecting an extending direction of the conductive member. The first engaging portions may include cuts arranged to coincide in a width direction. The cuts can be formed in each of the first engaging portions by cutting the mounting portion in the width direction using a cutting tool. This can simplify a cutting process as compared with the case where the mounting portion is cut to individually form the cuts, for example, using a drill.

These and other features and advantages of the invention will become more apparent upon reading the following detailed description of preferred embodiments and accompanying drawings. It should be understood that even though embodiments are described separately, single features may be combined to additional embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of a terminal block in a first embodiment.

FIG. **2** is a front view of the terminal block.

FIG. **3** is a plan view of the terminal block.

FIG. **4** is a rear view of the terminal block.

FIG. **5** is a bottom view of the terminal block.

FIG. **6** is a section along VI-VI of FIG. **3**.

FIG. **7** is an enlarged section of an essential part of FIG. **6**.

FIG. **8** is a perspective view showing a state where busbars and terminals are bolted in proper postures.

FIG. **9** is a plan view showing the state of FIG. **8**.

FIG. **10** is a section along X-X of FIG. **9**.

FIG. **11** is a section along XI-XI of FIG. **9**.

FIG. **12** is a section along XII-XII of FIG. **9**.

FIG. **13** is a perspective view showing a state where the busbar and the rotated terminal are bolted.

FIG. **14** is a perspective view of a bracket.

FIG. **15** is a plan view of the bracket.

FIG. **16** is a section, equivalent to FIG. **6**, in a second embodiment.

FIG. **17** is a perspective view of a bracket.

FIG. **18** is a plan view of the bracket.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

A first embodiment of the invention is illustrated in FIGS. **1** to **15** and includes a terminal block **10** that is to be mounted to a mounting device such as a motor case (not shown) made of conductive material (e.g. metal) and installed in a vehicle such as an electric vehicle or a hybrid vehicle. The terminal block **10** electrically connects terminals T and busbars B. The terminals T are connected to enameled wires (not shown) extending from a connection device, e.g. extending from a three-phase AC motor housed in the motor case. The busbars B extend from the connection device, e.g. from an inverter. Note that, in the following description, a vertical direction is based on that in FIG. **2**, forward and backward directions are based on a vertical direction of FIG. **9**, and a side where the busbars B are arranged (shown upper side) is referred to as a front side.

As shown in FIGS. **10** and **11**, the terminal block **10** has nuts **20** on which the busbars B and the terminals T are to be placed in a mounting direction MD (e.g. from above), a bracket **40** below the nuts **20**, an insulating plate **30** between the nuts **20** and the bracket **40**, and a resin portion **50** for integrally fixing these.

The busbar B is a substantially flat plate that vertically penetrates the bolt insertion hole B**1** in the mounting direction MD at a position to be placed on the nut **20**.

As shown in FIGS. **8** to **10**, the terminal T includes a bolt fastening portion T**1** in the form of a flat plate to be placed on the nut **20** and a barrel T**2** to which enameled wires are to be connected. A connecting part is between the bolt fastening portion T**1** and the barrel T**2** and is cranked so that the barrel T**2** is offset from the bolt fastening portion T**1**. The bolt fastening portion T**1** is formed with a vertically penetrating bolt insertion hole T**3**. Further, the barrel T**2** particularly is in the form of a substantially elliptical tube that is wide in the width direction WD, and substantially opposite widthwise end parts are rounded.

Each nut **20** is made of conductive material such as metal and, as shown in FIG. **3**, has a substantially rectangular plan view. A bolt fastening hole **21** is provided in a central part of each nut **20** and a bolt BT can be tightened therein. The nuts **20** are arranged in the width direction WD. The bolt fastening portion T**1** of the terminal T for power source and the busbar B are placed one over the other on each of the three middle nuts **20**. The bolt BT is inserted through the bolt fastening hole T**3** of the bolt fastening portion T**1** and the bolt insertion hole B**1** of the busbar B and tightened into the bolt fastening hole **21** of the nut **20** so that the terminal T and the busbar B are fastened together and electrically connected by the bolt BT and the nut **20**, as shown in FIG. **10**.

The bolt fastening portion T**1** of the terminal T for neutral point is placed on each of the nuts **20** on the opposite sides from above, the bolt BT is inserted through the bolt insertion hole T**3** of the bolt fastening portion T**1** and tightened into the bolt fastening hole **21** of the nut **20** so that the terminal T for neutral point is bolted to the nut **20** as shown in FIG. **11**.

The barrel T**2** of the terminal T is behind or offset from the nut **20** when the bolt fastening portion T**1** of each terminal T is fixed to the nut **20**.

A step **22** is formed over substantially the entire periphery on an upper peripheral edge of each nut **20**. As shown in FIGS. **10** and **11**, this step **22** is slightly lower than the upper surface of the nut **20** and is covered at least partly by a nut locking portion **52** of the resin **50** from above.

The insulating plate **30** is made of a highly heat conductive synthetic resin containing glass or talc and is sandwiched vertically by the nuts **20** and the bracket **40**, as shown in FIGS. **10** and **11**. A bottom plate **31** is arranged between the nuts **20** and the bracket **40** and is in the form of a thin flat plate. The lower surfaces of the nuts **20** are held in close contact with the upper surface of the bottom plate **31**, and the upper surface of the bracket **40** is held in close contact with the lower surface of the bottom plate **31**. Thus, heat of the nuts **20** is transferred efficiently to the bracket **40** via the insulating plate **30**.

The bottom plate **31** of the insulating plate **30** has bolt escaping recesses **32**, which are bottomed recesses that project down. Each bolt escaping recess **32** substantially corresponds to the bolt fastening hole **21** of the nut **20** arranged on the upper surface of the insulating plate **30**, and prevents interference of the bolt BT and the insulating plate **30** by allowing the tip of the bolt BT to escape when the bolt BT is tightened into the nut **20**.

The bracket **40** is formed by aluminum die casting and, as shown in FIGS. **14** and **15**, wide in the width direction WD. The rear surface of the bracket **40** is formed into a substantially arcuate or bent shape substantially in conformity with the shape of the motor case. As shown in FIGS. **10** and **11**, the bracket **40** includes an embedded portion **41** on which the insulating plate **30** is to be placed and that is covered by the resin **50**. A mounting portion **42** is connected behind the embedded portion **41** and is exposed from the resin portion **50**.

The insulating plate **30** is placed on the upper or outer surface of the embedded portion **41** and covers substantially the entire upper surface of the embedded portion **41**. Fitting recesses **43** are provided substantially side by side in the width direction WD on the upper surface of the embedded portion **41** and receive the bolt escaping recesses **32** of the insulating plate **30**. The insulating plate **30** is to be mounted on the upper surface of the embedded portion **41** without being displaced by fitting the bolt escaping recesses **32** into the fitting recesses **43**.

As shown in FIGS. **10** and **15**, the mounting portion **42** is provided on a lower rear end edge of the embedded portion **41** and is to be fixed to an attaching portion (not shown) on the motor case. As shown in FIG. **3**, through holes **42**A vertically penetrate opposite widthwise sides of the mounting portion **42**. Fixing bolts (not shown) are inserted through the through holes **42**A and tightened into the attaching portion to fix the bracket **40** and the terminal block **10** to the motor case.

As shown in FIGS. **5** and **6**, at least one arcuate heat radiation recess **44** is formed on the lower surface of the mounting portion **42** and extends in the width direction WD. The heat radiation recess **44** is recessed up and at least one cooling fin **45** projects down near the back wall of the heat radiation recess **44**. When the mounting portion **42** is fixed to the attaching portion of the motor case, coolant circulating in

the motor case can circulate substantially in the width direction WD in the heat radiation recess **44** and heat of the bracket **40** is efficiently radiated from the cooling fin **45**.

A substantially rectangular gate mark **46** is formed on the rear surface of the mounting portion **42** when a molding die is opened (see FIG. **2**) and defines a fracture mark of an aluminum die casting material. Although not shown, find edges formed when the aluminum die casting material is fractured maybe left on an outer peripheral edge of the gate mark **46** in some cases.

The resin portion **50** is made of synthetic resin and, as shown in FIGS. **10** and **11**, integrally fixes the nuts **20**, the insulating plate **30** and the bracket **40** while vertically holding them one over another in close contact by at least partly covering parts of these members. The resin portion **50** includes a main body **51** that collectively covers side surfaces of the nuts **20**, of the insulating plate **30** and of the embedded portion **41**.

A substantially rectangular nut locking portion **52** is provided on an upper part of the main body **51** and locks the step **22** of each nut **20** together with the insulating plate **30**. The nut locking portion **52** locks the step **22** of each nut **20** from above to prevent a clearance from being formed between the nut **20** and the insulating plate **30** when the bolt BT is tightened into the bolt fastening hole **21** of the nut **20** and the nut **20** is pulled up.

As shown in FIGS. **3** and **4**, partition walls **53** stand up from the main body **51** at positions between adjacent nut locking portions **52** and partition adjacent nuts **20**. Specifically, the partition walls **53** are arranged substantially side by side in the width direction WD and extend over the entire length of the main body portion **51** in forward and backward directions FBD. The height of the partition wall **53** exceeds the sum of the thickness of the bolt fastening portion T**1** of the terminal T and the thickness of the busbar B placed on the nut **20**, as shown in FIG. **10**. Thus, a distance at which insulation is maintained between adjacent bolt fastening portions T**1** and between adjacent busbars B is assured, i.e. a so-called insulation distance (creepage distance).

A guide **54** is provided of an upper end of each partition wall **53** at an intermediate part in forward and backward directions FBD, as shown in FIGS. **3** and **4**, and guides the busbar B and the terminal T with respect to the upper surface of the nut **20**. The guide **54** has a converging or pointed triangular shape that is long in forward and backward directions FBD and has oblique surfaces **54**A on opposite widthwise sides. Thus, the busbar B and the bolt fastening portion T**1** contact the oblique surfaces **54**A of the guides **54** and are guided onto the upper surface of the nut **20** even if the busbar B and/or the bolt fastening portion T**1** of the terminal T are displaced slightly in the width direction WD when placing the busbar B and the terminal T on the upper surface of the nut **20** in the mounting direction MD.

As shown in FIGS. **1** and **3**, a substantially plate-like posture correcting portion **55** extends back from the rear end of each partition wall **53**. The posture correcting portions **55** project up along the mounting direction MD from the upper surface of the mounting portion **42**. The posture correcting portions **55** on opposite widthwise sides meander in the width direction WD at positions near the partition walls **53** as shown in FIG. **3**, thereby forming crank portions **55**A bent toward the center.

As shown in FIG. **9**, the barrels T**2** of the terminals T placed on the nuts **20** are arranged at opposite widthwise sides of the posture correcting portions **55** with clearances defined in the width direction WD therebetween. As shown in FIGS. **10** and **11**, the height of the posture correcting portion **55** exceeds the height of the barrel T**2** located on a rear part of the terminal T, and a rear end part thereof extends more backward than the rear part of the barrel T**2**. When the terminals T are placed on the nuts **20**, the posture correcting portions **55** block between the barrels T**2** of adjacent terminals T to ensure a creepage distance (insulation distance) between adjacent barrels T**2**.

Further, if the terminal T is placed on the nut **20** from above and in the mounting direction MD with the barrel T**2** thereof displaced in the width direction WD, the posture correcting portion **55** contacts a lateral edge of the barrel T**2** in the width direction and corrects the posture of the barrel T**2** in the width direction WD to a substantially proper posture in which the terminal T is straight in forward and backward directions FBD. When the terminals T are placed on the nuts **20**, the adjacent barrel portions T**2** are blocked by the posture correcting portions **55** and the creepage distance (insulation distance) between the barrels T**2** is ensured even if the adjacent barrels T**2** are displaced slightly in the width direction WD, as shown in FIG. **13**.

The terminal T may rotate following the rotation of the bolt BT when tightening the bolt BT into the nut **20**. However, the posture correcting portion **55** contacts the barrel T**2** in the width direction WD to limit rotation of the terminal T and ensuring the creepage distance (insulation distance) between the adjacent barrels T**2**.

At least one projection **56** project substantially in the width direction WD on a rear end part of each posture correcting portion **55** for reinforcement. The projection **56** is formed over the entire height of the posture correcting portion **55** and is behind the barrel T**2** of the terminal T mounted in a proper posture on the nut **20**.

Projections **56** is provided on each of opposite widthwise sides of each of the two posture correcting portions **55** arranged in the intermediate position out of the posture correcting portions **55** to prevent the posture correcting portion **55** from being inclined in the width direction WD and broken when a lateral force acts on the posture correcting portion **55**. Further, one projection **56** is provided on each of the two posture correcting portions **55** arranged on opposite widthwise sides and projects toward the center to cooperate with the crank portion **55**A to reinforce the posture correcting portion **55**. Thus, the two posture correcting portions **55** arranged on the opposite widthwise sides prevent the posture correcting portions **55** from being inclined in the width direction WD to be broken when a lateral force acts on the posture correcting portions **55**.

The strength of the posture correcting portion in the width direction WD could be increased by setting the thickness of the entire posture correcting portion to the thickness of the part where the projecting portions are provided. However, if the thickness of the entire posture correcting portion is increased, the clearance between the posture correcting portion and the barrel becomes smaller. Even a slight displacement of the terminal T in the width direction WD may cause the barrel T**2** to move onto the posture correcting portion when placing the nut **20** on the terminal T. However, the clearance between the posture correcting portion **55** and the barrel T**2** is made larger by thinning the posture correcting portion **55** except at the part where the projections **56**. Thus the barrel T**2** easily can be arranged between the posture correcting portions **55** even if the terminal T is displaced slightly in the width direction WD when being placed on the nut **20**. This can improve mounting operability in placing the terminal T on the nut **20**.

The creepage distance between the barrels of adjacent terminals T may become shorter if the bolt insertion hole T**3** of the bolt fastening portion T**1** is large relative to the bolt BT

and the terminal T is bolted in a state slightly displaced backward. However, if the terminal T is displaced backward, the projecting portions **56** contact the barrel T**2** in the width direction WD and the posture of the terminal T can be corrected to approach a proper posture where the terminal T is substantially straight in forward and backward directions FBD. Thus, the required creepage distance (insulation distance) between the barrels T**2** is assured.

The projection **56** has two functions, namely, reinforcing the posture correcting portion **55** and correcting the posture of the terminal T. Thus, the structure of the posture correcting portion **55** becomes less complicated, as compared with the case where the reinforcing function and the posture correcting function are provide separately.

A first lock **57** is provided on a lower end part of the posture correcting portion **55** and engages a bottomed screw hole **47** provided on the mounting portion **42**.

The screw hole **47** of the mounting portion **42** has a screw groove **47**A on the inner peripheral surface and is formed by recessing the upper surface of a substantially cylindrical build-up portion **48** projecting from the upper surface of the mounting portion **42**.

As shown in FIG. **7**, the first lock **57** enters the screw hole **47** of the mounting portion **42** and the screw groove **47**A of the screw hole **47** by covering the build-up portion **48** of the mounting portion **42**. The first lock **57** locks an upper end **47**B of the screw groove **47**A from below when an upward pulling force acts on the resin portion **50**. Thus, the main body **51** of the resin portion **50** and the embedded portion **41** of the bracket **40** cannot be separated at a rear end of the resin portion **50** when the bolt BT is tightened into the bolt fastening hole **21** of the nut **20** and the resin portion **50** is pulled up together with the nut **20**.

Further, the first locking portions **57** and the screw holes **47** particularly are arranged substantially between adjacent nut locking portions **52**, and two nut locking portions **52** are supported by one first locking portion **57** and one screw hole **47**. That is, e.g. five nut locking portions **52** are supported by four first locking portions **57** and e.g. four screw holes **47** on the rear end side of the resin portion **50** and the numbers of the first locking portions **57** and the screw holes **47** can be reduced as compared with the case where the first locking portion is formed for each nut locking portion. This can prevent the bracket **40** and the resin portion **50** from being separated while simplifying the structure of the rear end side of the resin portion **50**.

The screw holes **47** are arranged in correspondence with and above the heat radiation recess **44** of the mounting portion **42** and formed in the build-up portions **48** on top of the mounting portion **42** so that a sufficient thickness is ensured between the heat radiation recess **44** and the screw holes **47**.

Although a screw hole is formed by cutting using a drill or the like, it is generally not possible to form a screw groove with a tip part of the drill. Hence, the depth of the screw hole is larger than the height of a part where the screw groove is provided. Thus, if it is attempted to form a screw hole with a predetermined dimension of a screw groove ensured above a heat radiation recess without providing a build-up portion on a mounting portion, a sufficient thickness cannot be ensured between the heat radiation recess and the screw hole and the screw hole cannot be provided above the heat radiation recess. However, the screw hole **47** is formed in the build-up portion **48** provided on top of the mounting portion **42**. Thus, the heat radiation recess **44** and the screw hole **47** can be formed vertically one above the other on the mounting portion **42** while ensuring a sufficient thickness between the heat radiation recess **44** and the screw hole **47**. Thus, the mounting portion **42** is not enlarged as compared with the case where the mounting portion and the heat radiation recess are displaced in forward and backward directions.

On the other hand, as shown in FIGS. **6**, **10** and **11**, a second locking portion **58** is provided on a lower end part of the main body **51** for locking an engaging portion **49** connected to a lower outer peripheral edge part of the embedded portion **41** and opposite lower lateral edges of the mounting portion **42** from below.

The engaging portion **49** is stepped to be raised slightly from the lower surface of the bracket **40** and is recessed slightly inward of the outer peripheral surfaces of the embedded portion **41** and the mounting portion **42**.

The second locking portion **58** is formed on an outer peripheral edge of the main body portion **51** except at a front edge part of the main body **51** to correspond to the engaging portion **49**, and at least partly covers the engaging portion **49** from below. That is, as shown in FIG. **5**, the second locking portion **58** is substantially U-shaped in bottom view and surrounds the embedded portion **41** over substantially the entire circumference together with the first locking portions **57** of the main body portion **51**.

Specifically, the first and second locking portions **57**, **58** of the main body **51** lock the bracket **40** from below in such a manner as to surround the embedded portion **41** over substantially the entire circumference and reliably prevent the resin portion **50** and the bracket **40** from being separated vertically.

To prevent the separation of a resin portion and a bracket, it is thought to provide a stepped engaging portion over the entire circumference on a lower outer peripheral edge part of the bracket and lock the engaging portion over the entire circumference from below by a locking portion of a main body portion by covering the side surfaces of the bracket and the engaging portion over the entire circumference by the resin portion. However, a heat radiation property of the bracket may be reduced if the outer peripheral surface of the bracket is covered over the entire circumference with resin. Further, a gate mark **46** formed when the bracket **40** is formed by die casting may be left on the rear surface of the mounting portion **42**. If that gate mark **46** is covered with resin, the resin portion may be broken, such as due to the formation of cracks from fine edge parts formed on an outer peripheral edge part of the gate mark **46**.

However, the mounting portion **42** is exposed from the resin portion **50** according to this embodiment. Thus, the resin portion **50** will not break while a heat radiation property of the bracket **40** is improved.

The busbars B extending from the connection device (such as the inverter) are placed on the upper surfaces (mounting surfaces) of the nuts **20** of the terminal block **10** mounted and fixed to the mounting device (such as the motor case) and, then, the terminals T connected to ends of the enameled wires extending from the mounting device (particularly the motor) are placed on the busbars B.

The busbars B may be displaced slightly in the width direction WD when the busbars B are placed on the nuts **20** from above and in the mounting direction MD. However, the lateral edges of the busbars B contact the oblique surfaces **54**A of the guides **54** and the busbars B are guided and placed onto the upper surfaces of the nuts **20**. Further, even if the terminals T are displaced slightly in the width direction WD, the lateral edges of the bolt fastening portions T**1** of the terminals T contact the oblique surfaces **54**A of the guiding portions **54** and the terminals T are guided and placed onto the upper surfaces of the nuts **20** similarly to the busbars B.

Further, in the case of the terminal T, even if the barrel T**2** is displaced in the width direction WD due to rotational

displacement of the terminal T in the width direction WD, the posture correcting portion **55** contacts the lateral edge of the barrel T**2** in the width direction WD so that the posture of the barrel portion T**2** in the width direction WD is corrected and the terminal T is placed on the nut **20** in a state where adjacent barrels T**2** are blocked by the posture correcting portion **55**.

The busbar B and the terminal T can be guided onto the nut **20** by the guiding portion **54** and the posture of the barrel T**2** of the terminal T can be corrected by the posture correcting portion **55** when the busbar B and the terminal T are placed on the nut **20**. Thus, the terminal T and the busbar B can be placed on the nut **20** while ensuring the creepage distance (insulation distance) between adjacent barrel portions T**2**.

The posture correcting portion **55** corrects the posture of the terminal T by contacting the barrel T**2** of the terminal T, and it is necessary to prevent the posture correcting portion **55** from being inclined in the width direction WD to be broken. It is thought to increase the thickness of the entire posture correcting portion to prevent the inclination of the posture correcting portion. However, if the thickness of the posture correcting portion is increased, the clearance between the posture correcting portion and the barrel becomes smaller and even only a slight displacement of the terminal T in the width direction WD may cause the terminal T to move onto the posture correcting portion, so that operability in mounting the terminal T on the nut **20** is reduced.

However, the projections **56** are provided only on the rear part of each posture correcting portion **55** and a part of the posture correcting portion **55** where the barrel T**2** is arranged is thinner. Thus, the barrel T**2** easily can be arranged between adjacent posture correcting portions **55** even if the barrel T**2** is displaced slightly in the width direction WD. This can improve operability in mounting the terminal T on the nut **20** while ensuring the strength of the posture correcting portion **55** in the width direction WD, as compared with the case where the thickness of the entire posture correcting portion is increased.

The bolt BT then is inserted through the busbar B and the bolt insertion hole T**3** of the bolt fastening portion T**1** and tightened into the bolt fastening hole **21** of the nut **20**.

The terminal T may try to rotate with the bolt BT when tightening the bolt BT into the nut **20**. However, the posture correcting portion **55** contacts the barrel T**2** in the width direction WD to prevent the terminal T from rotating.

Further, in case of plural terminals T, a distance between adjacent terminals T may become shorter and the creepage distance (insulation distance) cannot be ensured if the bolt insertion hole T**3** of the bolt fastening portion T**1** is large relative to the bolt BT and the terminal T is displaced slightly backward. However, the projecting portions **56** contact the barrel T**2** in the width direction WD and the posture of the terminal T can be corrected to approach the proper posture in which the terminal T is straight in forward and backward directions FBD if the terminal T is displaced backward. This can reliably ensure the creepage distance (insulation distance) between the barrels T**2**.

When the bolt BT is tightened completely into the bolt fastening hole **21** of the nut **20**, the busbar B and the bolt fastening portion T**1** are fastened together and electrically connected by the bolt BT and the nut **20**.

In the process of tightening the bolt BT into the nut **20**, the resin portion **50** is pulled up together with the nut **20** and the bracket **40** fixed to the mounting device (e.g. the motor case) and the resin portion **50** may be separated. However, the first locking portions **57** lock the upper ends **47**B of the screw grooves **47**A in the screw holes **47** provided on the mounting portion **42** from below on the rear edge of the main body portion **51** of the resin portion **50** and the second locking portion **58** locks the engaging portion **49** from below on the front edge and the opposite widthwise side edges of the bracket **40**. Specifically, the first and second locking portions **57**, **58** provided on the main body **51** of the resin portion **50** lock the embedded portion **41** from below and surround the embedded portion **41** over substantially the entire circumference. Thus, the bracket **40** and the resin portion **50** cannot separate.

A second particular embodiment of the present invention is described with reference to FIGS. **16** to **18**.

In a terminal block **11** of the second embodiment, the shapes of the build-up portions **48** and the first locking portions **57** of the first embodiment are changed. Configurations, functions and effects similar or common to the first embodiment are not repeatedly described. Further, the similar or same components as those of the first embodiment are denoted by the same reference signs.

Build-up portions **148** of a bracket **140** of the second embodiment are provided with one or more cuts **147** extending in the width direction WD instead of the screw holes. The cuts **147** are recessed forward from the rear end surfaces of the build-up portions **148**.

On the other hand, first locking portions **157** of the second embodiment cover the build-up portions **148** from above and enter the cuts **147** from behind. When a resin portion **50** is pulled up, the first locking portions **157** lock the cut portions **147** from below.

When forming vertically recessed cuts in build-up portions, it is thought to form the cut portions in the respective build-up portions individually, for example, using a cutting tool such as a drill, but as many cutting processes as the build-up portions are necessary. However, the cuts **147** of this embodiment can be formed in the build-up portions **148** by cutting the build-up portions **148** straight in the width direction, for example, using a cutting tool such as a T-shaped cutter. This can simplify the cutting process as compared with the case where the cuts are cut individually vertically, for example, using a drill or the like.

The invention is not limited to the above described embodiments. For example, the following embodiments also are included in the scope of the invention.

The busbar B and the terminal T are connected electrically in the above embodiments, but terminals may be electrically connected to each other.

Although the coolant of the motor case is circulated in the heat radiation recess **44** in the above embodiments, the present invention is not limited to such a mode. For example, the entire lower surface of the mounting portion may be held in close contact with the motor case to radiate heat of the bracket to the motor case without providing the radiation recess on the lower surface of the mounting portion.

Although the nut has a substantially rectangular plan view in the above embodiments, the present invention is not limited to such a mode. For example, the nut may have a substantially circular or elliptic plan view.

Although the nuts **20** for neutral point are provided on the opposite widthwise sides of the terminal block **10**, **11** in the above embodiments, the present invention is not limited to such a mode. For example, the nut for neutral point may be provided only on one side.

What is claimed is:

1. A terminal block for connecting a conductive members extending from a device and a mating conductive member, comprising:

nuts on which the conductive members and the mating conductive members are to be placed and that cooperate

with bolts to fasten the respective conductive member and the mating conductive member together;

a bracket made of metal and arranged substantially adjacent to the nuts, the bracket including at least one mounting portion to be fixed directly to a metal case for housing the device and an embedded portion; and

a resin portion that integrally fixes the nuts and the bracket by covering parts of the nuts and the embedded portion of the bracket

the resin portion including:

a first locking portion for locking a first engaging portion on the mounting portion of the bracket,

a second locking portion for locking a second engaging portion on the embedded portion of the bracket,

at least one partition wall for partitioning between adjacent ones of the nuts,

posture correcting walls aligned with the partition walls and extending perpendicularly from the mounting portion of the bracket, the posture correcting walls being adjacent positions where the conductive members are pulled out from the nuts and configured to correct postures of the conductive members in a width direction by contacting lateral edges of the conductive members,

reinforcing projections at ends of the posture correcting walls remote from the partition walls, the reinforcing projections projecting in toward the positions where the conductive members are pulled out and extending from the mounting portion of the bracket to positions on the posture correcting walls remote from the mounting portion of the bracket.

2. The terminal block of claim **1**, wherein a plurality of the nuts are arranged substantially in a width direction intersecting with an extending direction of the conductive member.

3. The terminal block of claim **2**, wherein the resin portion includes nut locking portions for locking outer peripheral edge parts of the nuts, the at least one partition wall being between adjacent ones of the nut locking portions while being connected to the nut locking portions.

4. The terminal block of claim **3**, wherein the first locking portion is provided on an end part of the partition wall.

5. The terminal block of claim **1**, wherein the lower surface of the mounting portion fixed to the case is recessed upwardly to form at least one heat radiation recess for radiating heat of the bracket by taking in coolant for cooling the interior of the case.

6. The terminal block of claim **5**, wherein the first engaging portion is formed by cutting a built-up portion provided above the heat radiation recess.

7. The terminal block of claim **1**, wherein the first engaging portion comprises a screw hole including a screw groove on an inner peripheral surface.

8. The terminal block of claim **1**, wherein the posture correcting walls align respectively with the first engaging portions.

9. A terminal block for connecting a conductive member extending from a device and a mating conductive member, comprising:

a fastening seat on which the conductive member and the mating conductive member are to be placed and that fastens the conductive member and the mating conductive member together with a bolt;

a bracket made of metal and arranged adjacent to the fastening seat; and

a resin portion that integrally fixes the fastening seat and the bracket by covering a part of the fastening seat together with the bracket, wherein:

the bracket includes at least one mounting portion at least partly exposed from the resin portion and to be directly fixed to a metal case for housing the device, and at least one embedded portion embedded in the resin portion; and

the resin portion includes a first locking portion for locking a first engaging portion provided on the mounting portion and a second locking portion for locking a second engaging portion provided on the embedded portion

a plurality of the first engaging portions are arranged in a width direction intersecting with an extending direction of the conductive member; and

the plurality of first engaging portions include one or more cut portions arranged to substantially coincide in a width direction.

* * * * *